REMARKS

Status of Claims

Claims 1-28 are present for examination.

Objections to the Specification

In response to paragraph 1 of the outstanding office action, applicant has corrected errors noted in the specification. It is pointed out that paragraph [0046] referred to in paragraph 1.a) of the outstanding office action appears to be in error and the correct citation appears to be [0036]. Applicant has made the appropriate corrections and has made additional changes to improve grammar.

Claim Objections and Rejections under 35 U.S.C. § 112

The Examiner has objected to the claims and has rejected the claims on 35 U.S.C. § 112, first and second paragraphs. Applicant has amended the claims to remove the various grounds of objections and at the same time has eliminated the § 112 second paragraph rejections due primarily to improved clarity and precision in the claim language. For example, Claim 1 recites defining a local area and an input image having a plurality of pixels. Further, the filtering operation recited in Claim 1 is applied to the target pixel utilizing the neighboring pixels and the target pixel. Further, the language concerning "successively assigned" the target pixel has been eliminated and replaced with more precise language as set forth in paragraph (c) of amended Claim 1. Similar changes have been made to all of applicant's independent claims. As such, it is submitted that the various grounds of rejection under 35 U.S.C. § 112, second paragraph and the objections to the claims have been removed.

With regard to the first paragraph rejections under § 112, the Examiner questioned how the local area may be defined when a pixel resides on an edge of the image.

It is well known in the art to select a target pixel, define a local area around the target pixel, perform processing, and then select another target pixel such that all pixels within a given image are eventually selected as the target pixel. The local area around the target pixel occupying an edge or corner of the image is obviously modified in these regions as is well known in the art. Indeed, Hayashi, applied by the Examiner, provides a teaching of how one

may modify the selection of the local area when the target area is an edge or corner of the image.

Specifically, Hayashi's Figs. 21 to 23 (especially, Fig. 23) disclose a manner of how the pixel block is defined when the target pixel is in an edge or border region or in the inside of the pixel block.

As seen from Fig. 23, the picture block 60 includes 8 x 8 pixels. When the target pixel is in one of the four corners, the picture region (local region) (which corresponds to the local area of the present invention) is defined as 1 x 1 pixel. When the target pixel is in one of the up and down ends and right and left ends, the picture region (local region) is defined as 1 x 3 or 3 x 1 pixels. When the target pixel is in the inside of the block 60 (i e., not in the edge region), the picture region (local region) is defined as 3 x 3 pixels.

As will be understood from the explanation, in the present invention, the defining manner of the neighboring pixels of a target pixel may simply be changed in the same manner as above dependent on the location of the target pixel in the local area.

For example, when a median filter is used for the filtering operation, the neighboring pixel or pixels is/are selected or defined in the same way as shown in Hayashi.

Regarding the explanation as to the wording "the filtered image having a jaggy different in phase from a jaggy in the input image", Fig. 3A clearly discloses the principle for jaggy edge elimination.

Generally, if two signals having different phases by 180° (which are the same in amplitude and period/frequency) are mixed, they cancel each other. In the invention, the jaggy edge elimination is realized by using this principle.

As shown in Fig. 3A, the oblique side of the black region of the input image 1A is step-shaped, thereby forming a jaggy edge, where each step includes two pixels. The filtered image 11A has a similar shape to the input image 1A. When the input image 1A and the filtered image 11A are mixed or added, the output image 3A is generated. The oblique side of the black region of the output image 3A thus generated is step-shaped. However, the black (white) pixel of the image lA near its oblique side and the white (black) pixel of the image 11A near its oblique side are superposed, resulting in gray pixels. Thus, each step of the output image 3A includes one pixel, which means that the jaggy edge in the input image 1A is eliminated.

Applicant has amended the claim language to better improve the recitation of the jaggy edge as explained above.

In view of the explanation set forth above, it is submitted that the rejections under 35 U.S.C. § 112, first paragraph have been overcome, and thus, these rejections must be withdrawn.

Rejections Over Prior Art

As seen from amended claim 1, the paragraph (b) includes the limitation of "said target pixel having one of pixel values included in said local area according to the filtering operation". This limitation was added to distinguish the invention from Hayashi reference. This limitation is clearly supported by the originally filed application, from page 20, line 18 to page 21, line 24.

The originally filed application states on page 19, lines 9-14 as follows.

"The median value extractor 11 provides a filtering operation that outputs the median value of the density or gray-scale levels of all the pixels (i.e., the pixel values) in a local area surrounding a target pixel of the input image 1. The median value is defined as a value in the middle of a series of the pixel values arranged in order of magnitude"

A further explanation as to the principle of the filtering operation is seen in the originally filed specification from page 20, line 18 to page 21, line 24.

Thus, in the present invention, the pixel values in the intermediate image 11A obtained through the filtering operation are not smoothed pixel values, although the smoothing effect of the contour of the input image 1A is obtainable. This is because the target pixel has one of pixel values included in the local area according to the type of the filtering operation."

In other words, the output of the filter (i.e., the median value extractor in Fig. 2) for a target pixel is not a smoothed value of the pixel values in the local area.

This feature is essential to suppress or eliminate jaggy edges at the contour of an input image. A smoothing operation is likely to induce blurs at the edges of an image.

On the other hand, Hayashi reference fails to disclose and teach such feature of the present invention as recited.

Hayashi's Fig. 2 discloses the configuration of the smoothing filter installed in the in-loop filter 23 or the post filter 26 in Fig. 1. Hayashi's Figs. 6 to 9 disclose the configurations to be added to the smoothing filter of Fig. 2, respectively.

Moreover, the following sentences are shown in Hayashi (column 15, lines 4-6, and column 5, lines 43-47).

"The sum taken in the sum circuit 236 is divided by the sum taken by the sum circuit 237, to obtain a smoothed pixel value."

"According to a first aspect of the present invention, a picture signal smoothing device that performs a smoothing process is performed by applying a smoothing filter in which a sampled and digitized picture signal is filtered by weighted mean of a target pixel and its surrounding pixels, ..."

Based on these disclosure by Hayashi, Hayashi's smoothing filter is carried out to obtain a smoothed pixel value of a target pixel by weighted mean of a target pixel and its surrounding pixels. Compared with the feature of the invention as explained above, it is apparent that this point is quite different from that of the invention as recited in the amended claims.

Furthermore, in Hayashi, the mixing ratio of a post-smoothing value of a picture signal and a pre-smoothing value thereof is appropriately changed in the embodiments. In applicant's invention, the mixing ratio is fixed in an input image. This is another difference between the invention and Hayashi.

An object of Hayashi is to eliminate blurs between picture blocks. Therefore, a local region (area) is first defined in an input image and then, a smoothing operation is applied to all the pixels in the local region (area).

In contrast, in the present invention, a target pixel is first defined in an input image and then, a local area is defined by the target pixel and its neighboring pixels. A filtering operation utilizing the target pixel and the neighboring pixels in the local region thus defined is applied to the target pixel alone. Thereafter, another pixel in the input image is selected or defined as the target pixel and then, another local area is defined by the new target pixel and its neighboring pixels. The same filtering operation is applied to the new target pixel alone. This sequence is repeatedly performed for all the pixels in the input image. As a result, all the

pixels in the input image are subjected to the filtering operation. (A local area is re-defined for a different target pixel in the input images.)

The differences between the invention and Hayashi is due to the differences in their objectives, where an object of the invention is to suppress or eliminate jaggy or blurred edges and contours, whereas an object of Hayashi is to eliminate blurs between picture blocks.

In view of the amendments made hereto and the comments set forth above, it is submitted that the § 102 and § 103 rejections have been overcome and that applicant's claims are patentable over prior art.

Conclusions

It is submitted that the application is now in condition for allowance and early indication of same is earnestly solicited.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If a petition of time is needed for timely acceptance of the instant document, such petition is hereby requested and the requisite fees are authorized to be deposited to the undersigned deposit account 19-0741.

Respectfully submitted,

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